



delaware / a.i.

# EFFICIENCY OPERATIONS

ADDING INTELLIGENCE TO YOUR  
**OPERATIONAL PROCESSES**

# THE AI SERIES

## 1/ OPERATIONS

delaware.ai has worked with numerous companies in a wide range of domains to incorporate feasible and impactful machine-learning solutions into operations. We get questions every day - not about what AI can do, but about how to implement AI to **tackle real-life use cases** on the production line and in service provision, maintenance, quality control and safety.

At this point, the benefits of intelligent processes are clear: automation, less waste, higher efficiency, increased margins. What's less clear are concrete actions to take to prepare your business for and to develop AI tools.

This e-book discusses how three domains of machine-learning technologies - **computer vision, natural language processing** and **intelligent devices** - can be applied in real business situations to add measurable value.

As you read, it's important to keep in mind that each business case is unique. However, these technologies can be adjusted, redesigned and tailored to suit many types of data and diverse operational challenges.

This e-book is the first in a series of e-books that will touch on different domains that delaware.ai is active in. Stay tuned for the next edition.

## 5 challenges



## data



## core technologies



# 5 challenges in operations

Rather than kicking off with trends, technologies or inspirational ideas in this e-book, we begin by describing five common challenges or situations found in operational settings. After identifying each challenge, we describe how delaware.ai developed a **machine-learning solution** - often with the help of partners Robovision and DataStories - to solve it.

In these five cases, you're likely to **recognize** some of your own challenges or **operational shortcomings**, all of which can be addressed by AI approaches.



## CHALLENGE 1

We've got too many people manually monitoring quality on our production line - and they don't do it consistently.

Is your current **quality control process lacking** - either because the automatic, traditional system you use isn't good at telling good products from bad, or because workers are inconsistently labeling products? Are too many good products being rejected, or bad products finding their way to consumers? The first leads to **inefficiency** and **waste**, and the second could **damage your brand reputation**.

**Computer vision**, one of the three core technologies we apply at delaware.ai, brings intelligence to the quality control and monitoring process. A deep-learning model analyzes images of goods on the production line, using knowledge it gathered from training data that is based on the insights of expert labelers. **This minimizes the quantity of good products thrown out and bad products reaching the market.**

## CUSTOMER STORY

# AUTOMATED QUALITY INSPECTION

Together with our partner Robovision, delaware.ai added intelligence to the visual quality inspection process at a company that manufactures complex components.

## The problem

The customer's existing system was good at identifying poor-quality components, but **threw away too many "good" components**.

## The approach

During the initial data intake process, our team collected a large quantity of product images and made sure that the labels weren't biased - i.e., that images labeled "good" were truly images of "good" products. Then, different deep-learning models were demoed and combined to achieve results that were neither too strict nor too lenient. Finally, the highest-performing combination was given data it had never seen before to see how well it works.

## The result

The deep-learning model analyzes images on a pixel by pixel basis with the ability to identify much subtler product characteristics. For example, products with superficial scratches were correctly labeled as "good", while those with defects affecting performance - like cracks or breaks - were discarded.



## CHALLENGE 2

The current laser-based counting solution for dangerous areas in our production environment isn't accurate, so we have to rely heavily on people and cameras.

**Keeping people safe and accounted for** is the **#1 priority** in every industrial environment. However, it's a fact that monitoring screens is a tiring, laborious and focus-draining task - for humans, at least. While people are excellent at identifying dangerous situations and counting people and vehicles, we can only do so accurately for limited periods of time.

**Computer vision** can also be used to effectively support your people in ensuring a complete overview of all key facility areas in real time, with extremely high accuracy in tracking employee and vehicle movements.

CUSTOMER STORY

# AUTOMATED PEOPLE MONITORING

Robovision teamed up with delaware.ai to help a manufacturing company ensure the safety of employees working in high-risk spaces through a camera system powered by deep learning.

## The problem

An existing laser-based counting solution **wasn't capable of accurately tracking people moving around the edges of the risky zones**. That led to false positives and put strain on the human employee that monitors the zones via camera.

## The approach

The team created a smart algorithm that identifies people frame by frame in video data on a real-time basis by measuring the distance between two points. The system was trained to recognize the specific protective clothing worn by employees, using the clothing items as a tracking compass.

## The result

The developed system relies on 12 cameras and is fully wired and self-contained – an achievement only possible thanks to Robovision's AI training simplification app. The hardware needed to achieve real-time, high-frame-rate tracking has a very small footprint.

Although it's still a proof of concept, the system is extremely fast and accurately tracks employee movements, even when they bunch together in groups or lurk in and out of a risk zone. Even more, it continues to refine its accuracy by learning from image data input by a human monitoring expert.





## CHALLENGE 3

We deal with huge quantities of unstructured text and have to comb through it manually to find the pieces of information we need.

Does your company have to **sift through text in multiple different forms** (on paper, in Word files, etc.) to find the right pieces of information to offer services to customers? Is SharePoint search not good enough to find the right legal documents or contracts in the right language?

Naming conventions in textual data change over time - which makes it even more difficult to find what you're looking for using traditional word-based searches. This can be in an administrative or legal setting, concerning intellectual property or in risk assessments of potential customers, to give just a few examples.

**Natural language processing** puts the power of text recognition and understanding into the virtual "hands" of a computer. Instead of using trained personnel to manually scan documents and text for key words, phrases or ideas, a machine-learning model can tag, grammatically analyze, extract terminology from and even understand the semantics of textual data. Your personnel can focus on other value-adding tasks and let the machines do the repetitive, time-consuming work.

## CUSTOMER STORY

# SEMANTIC SEARCH IN MULTIPLE LANGUAGES

A large multinational organization approached us with a cutting-edge challenge: finding relevant information quickly and accurately within a huge database of documents in several languages.

## The problem

Users needed to be able to **find the right information in their native tongue** - even if it was only available in another language. The large number of documents being searched was also labeled over a period of decades using a wide range of different naming/tagging conventions.

## The approach

The delaware.ai team developed a semantic search tool that improves search accuracy by identifying the meaning behind users' search terms and linking it with the concepts found in the content of the documents.

## The result

The solution takes the user's location, intent, word choices and natural language queries into account when searching. Exact word or terminology matches are no longer required for a user to identify information quickly and accurately - regardless of the language it's written in. The user simply has to express his/her intent - even if he/she is not sure exactly what he/she is looking for - and the semantic search tool automatically links it with relevant results.



**“With margins smaller and customers more demanding than ever before, production agility and efficiency are crucial competitive advantages.”**

## CHALLENGE 4

# Our production line generates too much waste.

Got a problem with scrap? Not sure what to tweak and where on your production line in order to maximize quality and minimize defects? Have you already taken measures such as water use reduction and recycling of waste materials, but still see too much production waste? All of these issues contribute to lower quality, inefficiency, poor use of resources and – of course – extra costs that can be avoided through an approach called **driver analysis**.

In driver analysis, production parameters are fed into a model that predicts the outcome of the production process based on these parameters. The parameters with the strongest effects on the modeled outcome are the 'drivers', which the process engineer can adapt to balance quality and resource use.

Production drivers are often known by a company's process engineers, but their knowledge is based on expertise and gut feeling rather than quantitative measurement. Through driver analysis, **delaware.ai transforms these gut feelings into a statistically sound model** that can be manipulated for different outcomes.

## CUSTOMER STORY

# FINDING DRIVERS IN PRODUCTION PROCESSES

A manufacturing company wanted to invest more in data science, and decided to address inefficiencies in its production process.

## The problem

Company leaders estimated that **hundreds of thousands of euros could be saved on waste while keeping quality high**, but they weren't sure which production parameters affected each other and the finished product. Company process engineers noticed that a different amount of expensive coating material would be returned by the line as waste after being applied to various types of materials.

## The approach

delaware.ai teamed up with DataStories, gathering measurements on coating viscosity, color, etc. as well as on the properties of the material receiving the coating, including surface area, and amount of coating applied. These parameters were fed into an algorithmic model with virtual production "knobs" that could be turned to strike the right balance.

## The result

Just enough coating is now applied to products in accordance with their different characteristics, for less wasted coating material and significant cost savings.



## CHALLENGE 5

We're not accurately meeting the market's demand for our products. This causes supply chain problems and logistics inefficiencies.

In the past, meeting market demand was mainly a guessing game. But with longer lead times and logistics processes, there was more time to compensate for changes. Even today, many companies prepare for the next month's production requirements using this month's data and then correct it as they go along. However, with margins smaller and customers more demanding than ever before, **production agility and efficiency are crucial competitive advantages.**

**Demand forecasting** is a statistical approach driven by machine learning that enables companies to accurately predict a specific client's demand for a specific product based on historical data models. This is especially useful for companies dealing with seasonal demand fluctuations, such as in food and beverage, construction, commodities, etc.

## CUSTOMER STORY

# SEASONAL DEMAND FORECASTING

An industrial firm that manufactures consumables was relying on sales data from the previous month to predict monthly demand for one seasonal product from one large customer.

## The problem

The company was suffering from **inaccuracies in demand prediction**, leading to production line, warehousing and logistics bottlenecks, holdups and overall inefficiency that was **affecting their relationship with the customer**.

## The approach

After the customer's implementation of a new ERP system, delaware.ai used sales data collected during the implementation to train a machine-learning model to calculate future demand from the customer based on historical demand figures.

## The result

The manufacturing firm is now able to accurately predict seasonal spikes and reductions in demand. As a result, it can meet its customer's needs and streamline processes along the entire supply chain - for a targeted market approach, cost savings and a stronger relationship with its customer.



# The importance, processing and storage of data

As you've likely gathered in reading our five cases stories, **without data, there is no AI**. Data is the driving force behind every intelligent automation initiative, and it can't just be any data: **it has to be relevant**. Relevant data is meaningful, objective, aligned with your operational goals and can be used to solve specific problems.

Just because your business is sitting on a lake of operations-related data doesn't mean that the data is useful for a machine-learning algorithm. The key to an effective, impactful machine-learning solution is to **collect data in function of what you want to achieve** with it.





**“The process of getting the data right takes up approximately 80% of the total time spent on an **AI project** – making it your **#1 investment.**”**

Relevant  
Relevant  
Relevant  
Relevant  
Relevant

## Relevant production data in action

A delaware customer in the food and beverage industry wanted to **optimize production processes** to improve the quality of their food product, but they had used subjective labels (ex. "good", "better", "best") given by human quality experts. As a result, the driver analysis we performed using this data didn't lead to useful insights about what to optimize during production.

We had to begin again with more **objective metrics**, such as acidity, mouthfeel, consistency, etc. in order to understand which elements of the production process impacted the quality of the end product. When we had these insights, we could "turn the knobs", so to speak, to get the desired outcome.



# 3 types of data

In operations - and machine learning in general - there are three main types of data used to **train effective intelligent automation algorithms**. Each type of data corresponds with a specific source technology, but we'll get into that in the next chapter of this e-book.

## 1 VISUAL DATA

Captured by cameras, visual data is composed of images that are tagged and categorized according to what they contain.

## 2 TEXTUAL DATA

This is captured by cameras or scanners or input as word processing files and web pages, and is organized into linguistically relevant characters, words, sentences and concepts.

## 3 NUMERICAL DATA

Numerical data consists of figures, metrics and measurements in number format gathered by machines, sensors or people.

# Data platforms 101

## - and why we recommend investing in one

**Collecting, storing and working with large amounts of data** usually benefits from the use of a data platform. Developing machine-learning models requires a number of different resources and tools, and the data scientists working with them need oversight and control over these resources - and data platforms enable just that.

A data platform collects data from devices (machines, cameras, etc.) and then sends it to a cloud platform, where it is stored in a database managed by a single data governance framework.

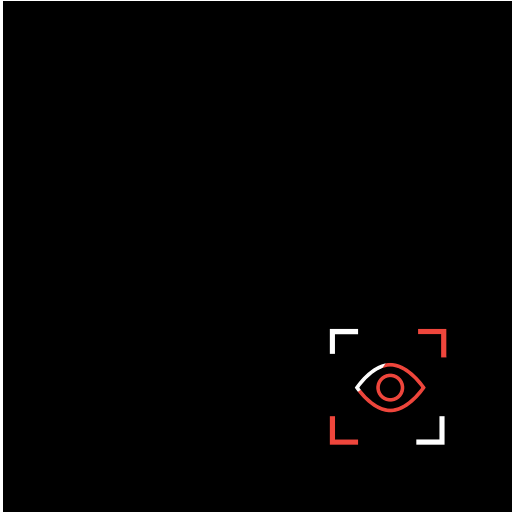
This makes it simple for your team to **transform any type of data into the right form** to visualize, inform decision-making or train a machine-learning algorithm.

Today, data platforms are powerful, cost-efficient and scalable, enabling users to update, modify and clean data in a hassle-free way. Without a data platform, you'll have to collect the data and rely more on the manual labor of your data scientists to manage, update and transform it.

# Core technologies

Corresponding with the three types of data we talked about in the previous chapter, there are **three types of technologies** used to process and analyze this data to automate what used to be human-performed processes, such as visual and linguistic processing and complex statistical analysis. However - machine learning does it faster, better, stronger and more.





# Computer vision

Just like the term implies, computer vision is when algorithms are trained to **recognize the contents of digital images** and video, automating visual tasks like quality inspection or monitoring that humans perform using their eyes and brains.

## delaware.ai and Robovision: a match made in deep learning

As mentioned in our cases, delaware partners with Robovision, a hardware and software company specialized in deep learning - the most powerful form of AI. RVAI, Robovision's **code-free, easily trained computer vision platform** brings scalable deep-learning insights to companies quickly - either on premises or in the cloud.

In working with us to bring intelligence to your operational processes, you get a flexible solution with an **easy-to-understand interface** that provides automatic labeling capabilities to accelerate the training and implementation of a computer vision AI model.



# Natural language processing

Machine-learning algorithms that are trained using linguistic rules and principles applied to textual data recognize, understand and even generate natural language. In fact, these algorithmic models **understand the meaning behind words, sentences and paragraphs**. This allows the same model to be applied to any language and identify relevant elements across multiple languages.

## Taking deep learning to even greater depths

delaware.ai relies on open-source libraries to develop NLP models based on deep learning. For production-ready systems, delaware.ai works with sPacy. However, the team is pushing boundaries by applying cutting-edge models such as Transformers.



# Intelligent devices, driver analysis and demand prediction

Driver analysis, demand prediction, regression and other statistical and machine-learning approaches use existing numerical data or rely on IoT sensors that measure production parameters or other metrics. By combining current and historical data, a machine-learning model **can estimate the importance of certain variables in predicting a specific outcome.**

## delaware.ai and DataStories combine excellent user experience with technical expertise

Another partner of delaware.ai, DataStories is a data analytics firm that has developed a unique **augmented analytics software platform** that requires no data science background to work with.

The platform **transforms data into interactive “stories” that are visualized in easy-to-interpret ways.** As a fully automated tool driven by a powerful computational engine and machine-learning models, the software generates rapid insights into which operational factors influence the outcomes you’re looking for. You can easily direct your focus to the areas that have the biggest impacts and simulate what would happen when changing parameters in the “what if” analysis.



# Access a complete AI ecosystem

From knowledge of tools, resources and approaches and data science expertise to deep experience in many applications, delaware.ai provides everything your business needs to **add intelligence to almost any operational process.**

## STRONG PARTNERSHIPS

Our partnerships with Robovision and DataStories enable you to achieve rapid results and hassle-free machine-learning implementations without the need for hard-to-find data science or AI expertise.

## INNOVATION & CO-CREATION

The DEL20 innovation ecosystem allows the most forward-thinking companies to experiment with emerging technology and data innovation. Business applications are tested and evaluated over the course of a year. Valuable learnings from each project are shared with the community.



## DELAWARE.AI ECOSYSTEM

## DELAWARE.AI EXPERTS

Our diverse team of data science and machine-learning experts have the experience and technological expertise to tackle any operational AI application. They are also deeply passionate about what they do.

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delaware.ai is  
ready to tackle  
any challenge.

Get in touch with us with your business case and take your operational processes to new heights in efficiency, productivity, automation and agility.